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DUES ARE DUE

Membership dues for 1972 are now payable. At the December 6 meeting of the Society, some rates were changed. The new schedule:

Regular memberships	$5.00
Family memberships (a new category which will receive only one copy of notices and newsletters. In making payment, please show names of all persons who are included; for example, Mr. and Mrs. John Smith; Robert and Jane Doe; Richard, Mary and Robert Roe)	7.50
College students	2.00
Students below college level	1.00

Send payments to: (old members) Ercell C. Woolford, 3797-A Sierra Dr, Honolulu HI 96816
(new members) Wayne Gagne, Ent. Dept, Bishop Museum, Honolulu HI 96816

PRINCIPAL PAPER

PROPAGATING NATIVE HAWAIIAN PLANTS [1/]

John Obata[2/]

Introduction

This article provides information on propagation derived from growing the flora native to Hawaii for the past ten years. An earlier paper (Obata 1967) dealt with experience on germination. About 130 genera have been studied. Some of the propagating techniques will also be discussed.

1/ Address to Hawaiian Botanical Society, October 4, 1971
2/ Science Teacher, Hawaii Department of Education

SHOUT
SHARE
IT

History of Native Hawaiian Plant Propagation

The Territorial Board of Agriculture attempted to propagate the native flora from about 1910 to 1925. After the foresters' repeated frustrations, especially with Metrosideros (Ohia lehua) and Acacia (koa), the two dominant native trees, Dr. H. L. Lyon probably epitomized the early thinking by summarizing that "the foresters were eventually forced to the conclusion that the only means of reforesting our watersheds would be to employ exotics . . . marvelous success obtained with such trees as Eucalyptus, Ironwood, Wattles, Monterey Cypress, and Silver Oak . . " (Lyon 1929). This conclusion probably abandoned all thoughts of reforesting with natives. Unfortunately some of the introductions have become noxious in the native forests and other areas.

Some of the present day awareness of the native flora can be credited to the late Dr. Joseph Rock. He early convinced Paul Weissich, then neophyte director of Honolulu Botanic Gardens, of the importance of trying to save some of our beautiful and rare or endangered native Hawaiian flora from being destroyed by feral animals (goats, pigs, sheep, deer, and cattle) and by land disturbances of our affluent society. This eventually led to the establishment of the Hawaiian garden section at the Wahiawa Botanic Garden on Oahu.

Individuals like George Munro single-handedly tried to grow some xerophytic natives along the slopes of Diamond Head. Personnel at the Hawaii Volcanoes National Park also did some extensive propagating from time to time. Morris (1967) summed the history of their work with their native flora. For the past several years the Lyon Arboretum, under the director, Dr. Yoneo Sagawa, and junior researcher, Robert Hirano, has made tremendous advances in propagating the native flora while the State Forestry Division and its predecessor agencies clung to the "Lyonian concept." Efforts like those of foresters L. W. Bryan and E. Pung at Manuka and Kawaihae-uka on the island of Hawaii were the exceptions.3/

Recent Propagation Efforts

Since this article will concern itself principally with the work done at the Honolulu Botanic Gardens and Wahiawa Botanic Garden, anecdotal history will suffice. Most of the germination and conditioning were done at the Honolulu Botanic Gardens. Most of the outdoor plantings were at Wahiawa Botanic Garden on Oahu.

Many surprises were encountered during germination and propagation. Most of the newly collected wild specimens from 1961 to 1962 seemed to expire almost as fast as they were collected. In 1965, potted plants from the hothouse were placed into the ground without much consideration to their native habitat. The planting crew, against our wishes, would dig deep cylindrical holes into the ground and ceremoniously plant each tree with much mulch and organic fertilizer. In this way many of the early plantings were waterlogged in poorly drained soil and expired within a year. Humidity at that time was considered critical so an extensive misting system was set up. The grounds personnel played havoc with the plants by inundating them with a constant stream of mist. We found that misting was not necessary.

3/ Editor's note.--The Division of Forestry has propagated and distributed considerable numbers of native plants, in recent years especially on Kauai.

Armed with a little more information, a more objective approach was taken. In 1966 another extensive planting was set in with huge Cibotium (tree fern) cover in the foreground. At the time it was thought that the Cibotium would enhance the garden and detract from the failures in the background. Time has proved us wrong as some species have grown beyond our fondest expectations. Buoyed by our successes and with our confidence restored, three additional areas were set aside and cleared. Today one area houses an extensive native hibiscus collection of eleven species with about thirty different clones. Another area houses an extensive stand of native Pritchardia (loulu palm). Sandwiched between these areas is a larger open hillside which hopefully will house much of the future plantings. There are about one hundred different species growing in varying degree of vigor. All plants have accompanying field data.

Cultural Observations - Greenhouse Propagation

Since many of the species grown were of the single or few specimen grown category, statistical analysis would not be meaningful. Based on our studies so far, germination seemed rather simple if one concentrated on plants from the low and middle altitudes (up to 914 meters/3,000 feet). If viable seeds were planted under greenhouse conditions with a sterile, artificial medium ("Perlite," "Vermiculite," sand, etc.), generally a higher rate of germination resulted as compared with sterilized soil, humus and nutrient mixture. Cuttings had a higher frequency of rooting with the artificial media. Sterilized soil mixtures had a low frequency of rooting.

Subsequent growth in the pot stage under greenhouse conditions was maintained with fungicidal controls. Many ferns, Liparis, Cheirodendron, Santalum, Schiedea, Broussaisia, many Peperomia, Viola, Isodendrion, Plantago, Nertera, and most lobeliads were at their cultural optimum only greenhouse plants, but failed to survive outdoor plantings. Joinvillea, Gunnera, Styphelia, Hillebrandia, Hesperomannia, and Vaccinium were notable failures even under greenhouse cultivation. Planting medium did not seem to be a critical factor as long as adequate drainage and aeration were maintained and the medium was not allowed to completely dry out. Our present planting medium is generally an equal portion of sterilized soil and mulch plus an additional 5 to 15% "Perlite."

Cultural Observations - Outdoor Propagation

Most of our critical problems arose during outdoor propagations. Many species failed to survive this stage. Smaller, younger transplanted seedlings seemed to develop faster than older, larger or pot-bound seedlings. It has been found that pot-bound seedlings in some species were difficult to establish in the ground. Generally, roots of transplants should not be disturbed or buried deeply into the soil. Direct transplants of collected wild seedlings usually did not survive. A conditioning period was needed. A seedling was not considered established until it had survived a year in the ground. Even then its survival was open to question. Most problems remain unanswered.

Controlling temperature, humidity, and photoperiods did help to bring about optimum conditions, but did not seem to be a critical factor as concluded previously (Obata 1967). However, some of the difficult to grow species showed better progress during cooler seasons.

Biotic and Abiotic Influences on Ground Transplants

Foremost in our concern was the survival rate of the new transplants into the ground. Generally, the first six months was the most critical period. Quite often a transplant seemed to go into "dormancy" for the first few months or even as long as two years with

no apparent reason. Many tender seedlings succumbed to severe sun exposures and lack of water. During the first six months, transplants were subjected to and often succumbed to a myriad of disease and phytophagous insects and nematodes. Plant pathogens took a severe toll on some species. The identity of these causative organisms has not been established. Destruction by some seemed to occur in a matter of a few days.

Insects and nematodes added to the decimation of established plantings through leaf, branch and root destruction. Of the phytophagous insects, the destructive ones seem to be exotics. In nature, we noticed that native insects are quite host specific, at most stenophagous. Swezey (1954) made similar observations. These native insects were usually controlled by natural predators, parasites or pathogens. Even if they invaded cultivated areas, exotic predatory insects and arachnids could annihilate them with ease.

But the control of exotic insects is a problem in itself. The most destructive exotic was the black coffee twig borer (Xylosandrus compactus). Nuisance types were the ants and insects associated with them (scales and mealybugs), the Chinese rose beetle (Adorectus sinicus) and assorted caterpillars (Lepidoptera). Some nutrient deficiency was indicated in leaf chlorosis, generally a lack of iron and not insect predation.

Some species showed viral symptoms without any apparent causative agents.

Many of the native flora lacked some degree of tolerance towards the various organo-insecticides, organo-phosphates being the most toxic. In this manner, insect control became a problem.

Nematodes seem to be another inhibiting factor because many established woody plants, and especially shrubs, appear to expire slowly with no other obvious symptoms. The use of nemacides seems most promising at this writing, but a degree of tolerance must be established for each species. A heavily aerated organic soil seemed to inhibit nematoid infestation.

Normal automobile exhaust and industrial fumes within the city limits of Honolulu seemed to have a little affect on growth for most species.

Discussion

Many consider temperature a major factor. This is true in that many of the higher altitude mesic (middle forest) flora seem to be temperate climate oriented. Several species have adapted as ornamentals in the temperate climates within the continental U.S. Many have potential as temperate zone ornamentals. But temperature generally cannot be considered as a direct inhibiting factor. There are indications that temperate climates restrict the development of the phytophages and inhibiting organisms. In lowland plantings, these uncontrolled organisms seem to play havoc with the mesic flora. On the other hand the xerophytes generally seem to adapt well to lowland cultivation because they have "adapted" to these situations in their natural habitat. They seem, however, to be rather susceptible to fungal diseases when planted in wetter lowland habitats. One may assume that temperature in itself does not seem to be the all inclusive inhibiting factor for growth, but a secondary factor. Many mesic species grown under protected greenhouse situations survived with no apparent difficulty when grown in sterilized media and given just fungicides. This not to infer that cooler temperatures have no effect. It does have some effect, but not a culturally critical one at least in the pot stage for plants found below 1067 m. (3500 feet).

Many coastal species developed normally in the greenhouse in various sterilized, potted media. The change in pH did not seem to affect the growth. Nematoid and fungal

activities developed when they were planted out-of-doors and many could not adapt to the changes. This seems to suggest that these plants are not restricted only by an edaphic barrier.

Recent successes with cuttings seem to dictate propagation of desirable clones by this method. Tissue culture may enhance proliferation of difficult to germinate species or clonal multiplication of disease "resistant" strains.

The rarity of Hesperomania, Joinvillea and many of the lobelias is puzzling. Under cultivation these species have been rather susceptible to fungal and bacterial diseases. They seldom progressed beyond the seedling stage without the use of fungicides and bactericides. Rarity in nature may be attributed to inability to adapt to "exotic" biotic inhibitors. At least lobelias tend to disappear with the encroachment of man and his sundry products that he carries with him in nature.

Equally mystifying is the inability to grow the common Styphelia (pukiawe) and the fern, Gleichenia (uluhe). In nature, these plants grow with ease from the lowlands to the higher altitudes under some of the apparently more uninviting habitats. Germination and seedling transplants have failed under all the techniques tried. Perhaps we are not aware of "mychorrizal activity."

Conclusion

Propagating the native Hawaiian flora for ornamentals and for reforestation purposes does not seem as remote as we have been led to believe. There are distinctly encouraging possibilities among Canthium, Dodonea, Pittosphorum, Hibiscus, Pritchardia, Tetraplasandra, several of the xerophytes and coastal species for plantings in the lowland.

Based on our findings xerophytes (drier forest plants) generally seemed to be the ones that will be most suitable for ornamentals in the drier lowlands with some exceptions. The mesophytes (wetter forest; between the xeric and rain forests) generally have difficulty adapting to drier lowland conditions, but many generally seem to survive wetter valley uplands. However, there are many species that overlap the xeric and mesic forests and there are several species that seem to adapt to both conditions equally well. An individual annotation of each species following this discussion should shed more light on this subject.

We have found that adequate drainage and air movement were among the more important factors in native plant propagation. These two factors seemed to "retard" the activities of bacteria, fungi and nematodes, perhaps because they did not provide suitable conditions for them.

A very serious enemy is the black coffee twig borer (Xylosandrus compactus) in the native forests and among cultivated natives and exotics. This insect appears to bar some of the natives that might be grown as ornamentals. Biological control may be instituted, but a parasite has not been found yet. Some species such as Drypetes phyllanthoides may face extinction because of this insect. Only DDT, now banned, seemed to have controlled this insect.

Many problems remain unanswered. There has been no study on the mutualistic microbial behavior patterns, very little work on edaphic factors, minimal study in plant pathology, and hardly any work on arachnid, insect and nematode control among the native flora. Some inroads have been made, but they are comparatively few. Financial support is needed for research in these areas. Most students require funding although my work has been done without special assistance.

As yet no one has been able to provide an "adequate formula" for growing the majority of kinds of our native Hawaiian flora. I am not ready to propose any.

Acknowledgements

Acknowledgements are made to Paul Weissich, Director of Honolulu Botanic Gardens, Masaichi Yamauchi, plant propagator at Honolulu Botanic Garden and Robert Hirano, junior researcher, Lyon Arboretum, and many other individuals too numerous to mention, that have aided and encouraged me through the years. Hopefully, there will be others that will carry on and open broader vistas.

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NOTE: A synopsis of the author's experiences in propagating individual species of native plants will be published in future issues of the NEWSLETTER. Ed.

EVENTS

Harold St. John Plant Science Laboratory

At a dedication ceremony held on Monday, November 29, the new plant science facilities at the University of Hawaii were named in honor of Dr. Harold St. John. Manoa Chancellor Richard Takasaki presided. President Harlan Cleveland presented a welcoming address, which was followed by remarks by Shiro Amioka, Superintendent of the State Department of Education, and Oliver Holtzman, Acting Chairman of the Plant Sciences Advisory Committee. Charles Lamoureux gave a biographical sketch of the honored guest, Harold St. John, who spoke to the assembly on the importance of plant sciences in Hawaii, and planted a specimen of Hibiscus saintjohnnianus Roe, a species discovered by him and Lamoureux in

1955 in the Na Pali area on Kauai. Tours through the St. John Plant Science Laboratory and the Willis T. Pope Environmental Laboratory were conducted by Beatrice Krauss and Bruce Cooil.

Citrus Field Day - Waimanalo Research Station

The results of recent citrus research in the College of Tropical Agriculture and the Hawaii Agricultural Experiment Station were presented on Wednesday, November 10th for nurserymen, farmers and agriculturalists. Visitors saw the heavily producing tangerine and orange experiments and sampled the quality of the fruits. They tasted and compared the fruits and finally toured the Plant Science Instructional Arboretum which has over 100 species and varieties of citrus. The effects of rootstocks on fruit quality and resistance of virus diseases and soil pathogens were demonstrated and several new tangerines and other citrus were on display.

Disease problems of citrus were discussed by Albert Martinez; insect and mite problems by Wallace C. Mitchell and Frank H. Haramoto; soil and fertility problems by Robert L. Fox; rootstocks and cultural problems, Robert M. Warner; yields and production of citrus in Hawaii, Warren Yee; citrus introductions, R. A. Hamilton.

New Botany Course

A new botany course entitled "Plants in the Hawaiian Environment," will be offered at the UH Manoa Campus during spring semester. This 4 credit course, Bot 197, for non-majors is designed to increase awareness of the unique nature of endemic Hawaiian plants. The instructor, William Theobald, plant systematist, has included units on speciation in Hawaii, plant communities in the Hawaiian Islands, interaction between native and exotic species, and man's influence on the flora. Numerous habitats on Oahu will be visited during weekly field trips.

New Federal Forestry Research Funds for Hawaii

In April 1971, a local newspaper reported that Senator Hiram L. Fong was supporting plans for new U. S. Forest Service research in Hawaii to be financed by an appropriation of $250,000, mostly for watershed protection studies and intensive timber culture research. Dr. Keith Arnold, Deputy Chief, Research, was reported as saying at Appropriations Sub-committee hearings that the fast growing southern pines could provide Hawaii with all the construction timber it needs, "but we must learn how to do it and at the same time not disturb the watershed." Senator Fong said it was heartening to learn that with this research, Hawaii might become self-sufficient in construction lumber, which is one factor in the high construction costs.

This news article left unanswered a number of questions, and as a result I asked Senator Fong in July for additional information about the proposed program: "Will the proposed funding bring about the clearing of presently established native forests which contain rare flora and fauna? Will the new work on pine trees displace research on koa?"

The Senator replied assuring me that there are no plans to disturb established forest areas with federal research funds:

> "The planting of southern pine would be in areas where the trees have already been cut and in brush lands where there is need to reestablish island forests. The U. S. Forest Service recognizes the importance of maintaining native forests for watershed, recreation, and for the

preservation of rare flora and fauna. Accordingly, it has no plan to destroy native forests in order to plant southern pine. The planting will will follow the practice of intensive timber culture, requiring relatively less land area.

"Research on valuable koa will not be displaced. The request for additional funds is to expand the present research to obtain more ecological knowledge and to protect our unique ecosystem from the current impact of insects and disease, and to restore the productivity of native forests."

In closing, he referred me for further information to Robert E. Nelson, Project Leader of the Institute of Pacific Islands Forestry, Honolulu. I met with Mr. Nelson in September and can thus give a clearer picture of the planned forest research. First, final Congressional approval has been received for a very substantial supplement to the previous level of funding, which was $164,000, with the new total being $414,000. Second, the publicized southern pine research in actuality will be only one of five program areas, and was much overemphasized in the news from the Appropriations Committee.

Dr. Arnold reported that Senator Fong's staff had sought information from his office on koa and ohia dieback. He said much of the increased funds will be devoted to studies of native trees. Work on exotic hardwoods will be continued.

In another letter, Mr. Richard Droege, Acting Chief, Forest Service, itemized some of the problems that were suggested for immediate study with the new funds.

1. Determine factors causing the decline of the native species of ohia and koa, the final objective being to develop control measures and management practices that will protect these unique ecosystems and restore their vigor.

2. Develop controls for noxious plants that inhibit tree growth, particularly banana poka.

3. Identify the reproduction and growth requirements of the mamani forests on Mauna Kea, and the impact of wildlife.

4. Continue adaptation trials including species with potential for advanced landscape management and environmental improvement.

5. Determine the effects of species introduction and forest management practices on native flora and fauna.

6. Determine water infiltration rates and other hydrologic characteristics of soil types and land surfaces under major alternative land uses.

7. Determine on a watershed basis the effects on water yield and quality of combinations of management practices.

He also stated:

"The rapid population growth is placing increased demands for urban development of forest lands, and particularly for the use of forests for recreation and amenity values. We believe that it is very important that our research program be responsive to these environmental needs of the people of Hawaii."

According to Mr. Nelson, there is a high degree of flexibility in the administration of the funds locally. A considerable amount of support will likely be provided to qualified

scientists from institutions such as the Bishop Museum and University of Hawaii. For example, U. H. plant pathologists and graduate students might be funded for studies of the fungus, Armillaria in the native forest.

I hope this report has presented a clear picture of this development which may set the course for forestry research in the 1970's. It should open new opportunities to bring together the diverse resources now at hand in the State and to contribute to the understanding of Hawaii's forest ecosystems.

Steven L. Montgomery
Vice-President

Arbor Day

U. H. Pearl Harbor Educational Facility.--A Norfolk-Island-Pine was planted by Girl Scouts. Botanical Society was represented by Retired State Forester Walter Holt and President-Elect Ruth Gay.

Lanai.--A Norfolk-Island-Pine planted by Boy Scouts. Botanical Society represented by President Ron Hurov.

Kahoolawe.--Plantings here were not sponsored by the Botanical Society, but members participated. Two each, kukui and koai'a, planted by U. S. Navy and Hawaii Division of Forestry. Botanical Society represented by State Forester Tom Tagawa, Editor Russ LeBarron, and C. D. Whitesell of I.P.I.F. The latter also planted 183 trees of various species within previously established test sites. As an experiment, Maui District Forester Wesley H. C Wong, Jr. scattered one pound each of seeds of four native dry land species from Kanepuu on Lanai:

Mao (Gossypium tomentosum)
Lama (Maba sandwicensis)
Naio (Myoporum sandwicense)
A'alii (Dodonaea viscosa)

New Research Plan Released

"Forest Conservation Research Plan for the Seventies," Department of Land and Natural Resources, up-dates and extends a similar plan entitled "A Wildland Research Plan for Hawaii" which was prepared in 1960. Numerous organizations and individuals contributed to the report. Copies may be obtained from the Hawaii Division of Forestry, 1179 Punchbowl Street, Honolulu, Hawaii 96813.

Planned Utilization for the Lowland Tropical Forests

This was the title of a conference in Tjipajung, Indonesia, August 12-14, 1971. Attendance, 80 persons, chiefly botanists and foresters from 17 countries. Hawaii was represented by Drs. St. John, Doty, Lamoureux, Stuart, and Mueller-Dombois.

The symposium theme was developed in the following subsections:

1. Inventory or stocktaking of biological resources in the tropical rain forest. It was emphasized that planned utilization requires a good knowledge of at least the botanical components of the forest ecosystems.

2. Ecosystem evaluation and classification. This topic dealt with problems of forest land classification on an ecological basis.

3. Conservation of lowland tropical forests in Pacific and Asian countries. A report on the status of forest reserves in Indonesia indicated that many of these are currently endangered by logging. Timber licenses have been given in the last 2 years to a number of foreign companies, (particularly, Japanese, U. S. and European companies). Where these are given out adjacent to reserves very often logging has already progressed right into these reserves, particularly now in S & E Borneo. The problem is one primarily of control of timber license boundaries, but also of lack of knowledge of how far logging should proceed in the tropical lowland forests without fully understanding the ecological results.

4. Forest conditions in the Pacific Islands. It was reported that very few original island forests are left. Moreover, that the few left are not assured to be there very much longer unless specific efforts are made to preserve some of them. Only on Guam a few "Conservation Reserves" have been established that seem to be well protected.

5. Wildlife. It was pointed out that certain natural forests in the lowland tropics have an important function in the maintenance of wildlife populations, a use-aspect not often included in forest management.

6. Productivity aspects. It was shown that the total biomass accumulation does not differ greatly among temperate and tropical forests. However, net production of organic carbon increases from near 3 tons/ha/yr to near 15 tons/ha/yr from temperate to tropical forests.

7. Plant products. A list of forest products other than wood was presented from Indonesian lowland rain forests. These include rubber, dyes, resins, oils, sugar, starch, and various drugs. It was pointed out that in 1967 forest exports consisted of more than 100 forest products, while in 1969, timber was the only export product in Kalimantan Timur (E. Borneo). This presents a tremendous reduction in diversity of use-products, which will directly affect the local inhabitants of rain forest terrains.

8. Education and communication. The Regional Center for Tropical Biology (BIOTROP) will establish a new role by inviting experienced scientists to work with Asian students on resource problems of their own countries. This represents a departure from the previous practice of sending Asian graduate students to foreign countries, where they often worked on problems unrelated to their own country. As a result, the homecoming graduate often had difficulties adjusting to his own country's resource-problems.

During the discussions, it became apparent that a new orientation in resource-utilization will need to be pursued. This is a shift away from mere considerations of productivity or yield per unit land area per year or decade to a concept of balanced utilization that takes into consideration the various cover crops, such as agric. crops, grass and pasture, planted forest and natural forest. These different cover crops should be considered in the frame-work of ecological regions, e.g., drainage basins. Here, the productivity and use of each should be studied and maintained in balanced proportions that insure sustained yield of an entire landscape unit.

Dieter Mueller-Dombois

PROCEEDINGS OF THE SOCIETY

The following are not complete minutes - only a few highlights:

November 1, 1971

1. Plant donations (included some tasty hybrid citruses).
2. Discussion of drainage canals, Ala Moana Park and effect on trees.
3. Discussion of hapuu harvesting in Hawaii island.
4. Nomination of officers.
5. Speaker of the evening, William C. Look, Chief Plant Inspector, The State Plant Quarantine Program.

December 6, 1971

1. Election of officers. (See last page for new officers.)
2. Report of Treasurer: Our financial situation is lousy. Result: Annual dues changed. See page 1.
3. Speaker of the evening, Ronald Hurov, Retiring President, "New Crops for Hawaii and the Tropics"

PUBLICATIONS

Recent Literature

Degener, Otto and Isa Degener 1970
The following pages of Flora Hawaiiensis:
D: Sherff
124:Anemone:Hupehensis
124:Ranunculus:Plebeius
274:Tibouchina
274:Tibouchina:Urvilleana
344:Elephantopus
344:Pseudelephantopus:Spicatus
344:Lipochaeta:Porophila

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Review and comments about a thing. Phytologia vol. 21(6): 369-374.

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THE HAWAIIAN BOTANICAL SOCIETY was founded in 1924 to "advance the science of Botany in all its applications, encourage research in Botany in all its phases," and "promote the welfare of its members and to develop the spirit of good fellowship and cooperation among them." Any person interested in the plant life of the Hawaiian Islands is eligible for membership in this Society. Dues; regular, $5.00 per year; family, $7.50; college students, $2.00; students below college level, $1.00.

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